PB-240 226

BUFFALO LAKE, WRIGHT COUNTY, MINNESOTA

Pacific Northwest Environmental
Research Laboratory

Prepared for:

National Environmental Research Center
Minnesota Pollution Control Agency
Minnesota National Guard

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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivded according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
eutrophication lakes nutrients phosphorus nitrogen loading		05B 05C

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REPORT
ON
BUFFALO LAKE
WRIGHT COUNTY
MINNESOTA
EPA REGION V
WORKING PAPER No. 88

WITH THE COOPERATION OF THE
MINNESOTA POLLUTION CONTROL AGENCY
AND THE
MINNESOTA NATIONAL GUARD
DECEMBER, 1974

1a

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Minnesota Pollution Control Agency for professional involvement and to the New York National Guard for conducting the tributary sampling phase of the Survey.

Grant J. Merritt, Director of the Minnesota Pollution Control Agency, John F. McGuire, Chief, and Joel G. Schilling, Biologist, of the Section of Surface and Groundwater, Division of Water Quality, provided invaluable lake documentation and counsel during the course of the Survey; and the staff of the Section of Municipal Works, Division of Water Quality, were most helpful in identifying point sources and soliciting municipal participation in the Survey.

Major General Chester J. Moeglein, the Adjutant General of Minnesota, and Project Officer Major Adrian Beltrand, who directed the volunteer efforts of the Minnesota National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

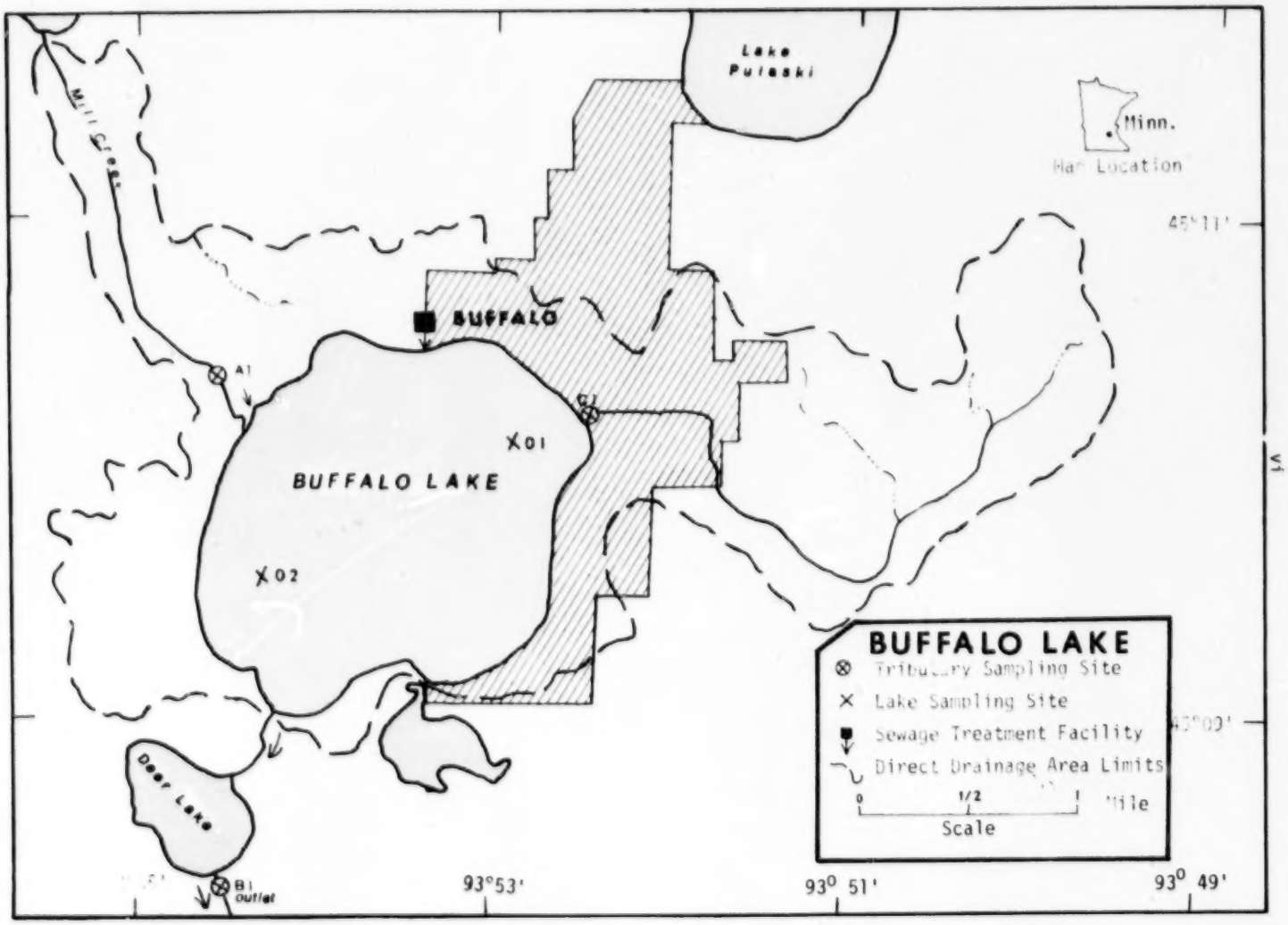
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MINNESOTA

LAKE NAME	COUNTY
Albert Lea	Freeborn
Andrusia	Beltrami
Badger	Polk
Bartlett	Koochiching
Bear	Freeborn
Bemidji	Beltrami
Big	Stearns
Big Stone	Big Stone, MN; Roberts, Grant, SD
Birch	Cass
Blackduck	Beltrami
Blackhoof	Crow Wing
Budd	Martin
Buffalo	Wright
Calhoun	Hennepin
Carlos	Douglas
Carrigan	Wright
Cass	Beltrami, Cass
Clearwater	Wright, Stearns
Cokato	Wright
Cranberry	Crow Wing
Darling	Douglas
Elbow	St. Louis
Embarass	St. Louis
Fall	Lake
Forest	Washington
Green	Kandiyohi
Gull	Cass
Heron	Jackson
Leech	Cass
Le Homme Dieu	Douglas
Lily	Blue Earth
Little	Grant
Lost	St. Louis

LAKE NAME	COUNTY
Madison	Blue Earth
Malmedal	Pope
Mashkenode	St. Louis
McQuade	St. Louis
Minnetonka	Hennepin
Minnewaska	Pope
Mud	Itasca
Nest	Kandiyohi
Pelican	St. Louis
Pepin	Goodhue, Wabasha, MN; Pierce, Pepin, WI
Rabbit	Crow Wing
Sakatah	Le Sueur
Shagawa	St. Louis
Silver	McLeod
Six Mile	St. Louis
Spring	Washington, Dakota
St. Croix	Washington, MN; St. Croix, Pierce, WI
St. Louis Bay	St. Louis, MN; Douglas, WI
Superior Bay	St. Louis, MN; Douglas, WI
Swan	Itasca
Trace	Todd
Trout	Itasca
Wagonga	Kandiyohi
Wallmark	Chisago
White Bear	Washington
Winona	Douglas
Wolf	Beltrami, Hubbard
Woodcock	Kandiyohi
Zumbro	Olmstead, Wabasha



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BUFFALO LAKE

STORET NO. 2713

I. CONCLUSIONS

A. Trophic Condition:

Survey data and the data of others show that Buffalo Lake is eutrophic. Of the 60 Minnesota lakes sampled in the fall of 1972 when essentially all were well-mixed, 43 had less mean total phosphorus, 46 had less mean dissolved phosphorus, and 47 had less mean inorganic nitrogen. Of the 80 Minnesota lakes sampled, 47 lakes had less mean chlorophyll a, and 37 had greater mean Secchi disc transparency.

Survey limnologists noted algal blooms during the June and August sampling dates. Also, rooted aquatic vegetation was present in the shallow areas of the lake.

B. Rate-Limiting Nutrient:

The algal assay results show that nitrogen was the limiting nutrient at the time the sample was collected. Also, the lake data show that N/P ratios were less than 14/1 on all sampling occasions, and nitrogen limitation would be expected.

C. Nutrient Controllability:

1. Point sources--During the sampling year, Buffalo Lake received a total phosphorus load at a rate over three times the rate proposed by Vollenweider (in press) as "dangerous"; i.e.,

a eutrophic rate (see page 13). It is calculated that the City of Buffalo contributed about 56% of the total phosphorus load.

Complete removal of phosphorus at the point source would reduce the loading rate to 0.61 $g/m^2/yr$. This rate is still in excess of the eutrophic rate; and, while at least some improvement of the trophic condition of the lake would be expected, it appears that non-point source phosphorus control (see below) would be necessary to bring about a substantial improvement in the trophic condition of Buffalo Lake.

2. Non-point sources (see page 13)--The phosphorus exports of the Buffalo Lake tributaries were very high as compared to the mean phosphorus export of the three tributaries of nearby Clearwater Lake* (53 $lbs/mi^2/yr$). The high export rates and the low N/P export ratios indicate unknown point sources in the drainage that may be amenable to control. A need for further study of the high phosphorus export rates is indicated.

In all, it is estimated that non-point (?) sources contributed about 43% of the total phosphorus load to Buffalo Lake during the sampling year.

* Working Paper No. 93.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry†:

1. Surface area: 1,510 acres.
2. Mean depth: 14.5 feet.
3. Maximum depth: 30 feet.
4. Volume: 21,895 acre/feet.
5. Mean hydraulic retention time: 1.4 years.

B. Tributary and Outlet:
(See Appendix A for flow data)

1. Tributaries -

Name	Drainage area*	Mean flow*
Mill Creek	30.2 mi^2	15.3 cfs
Unnamed Creek (C-1)	2.8 mi^2	1.6 cfs
Minor tributaries & immediate drainage -	8.6 mi^2	5.2 cfs
Totals	41.6 mi^2	22.1 cfs

2. Outlet -

Mill Creek	44.0 mi^2**	22.1 cfs

C. Precipitation***:

1. Year of sampling: 26.9 inches.
2. Mean annual: 25.6 inches.

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† DNR lake survey map (1964); mean depth by random-dot method.
* Drainage areas are accurate within ±5%; mean daily flows are accurate within ±10%; and ungaged flows are accurate within ±10 to 25% for drainage areas greater than 10 mi^2.
** Includes area of lake.
*** See Working Paper No. 1, "Survey Methods".

III. LAKE WATER QUALITY SUMMARY

Buffalo Lake was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two stations on the lake and from two or more depths at each station (see map, page vi). During each visit, a single depth-integrated (near bottom to surface) sample was composited for phytoplankton identification and enumeration; and during the last visit, a single five-gallon depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected for chlorophyll a analysis. The maximum depths sampled were 15 feet at station 1 and 15 feet at station 2.

The results obtained are presented in full in Appendix B, and the data for the fall sampling period, when the lake essentially was well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix B.

A. Physical and chemical characteristics:

Parameter	Minimum	Mean	Median	Maximum
		FALL VALUES (10/26/72)		
Temperature (Cent.)	5.8	6.0	6.0	6.3
Dissolved oxygen (mg/l)	11.8	11.9	11.9	12.0
Conductivity (μmhos)	400	410	410	420
pH (units)	8.8	8.8	8.8	8.9
Alkalinity (mg/l)	171	175	175	181
Total P (mg/l)	0.197	0.214	0.211	0.232
Dissolved P (mg/l)	0.147	0.162	0.161	0.179
NO_2 + NO_3 (mg/l)	0.100	0.193	0.200	0.240
Ammonia (mg/l)	0.300	0.570	0.620	0.630
		ALL VALUES		
Secchi disc (inches)	22	41	22	78

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
06/30/72	1. Anabaena	14,318
	2. Dinobryon	758
	3. Synedra	454
	4. Mallomonas	303
	5. Asterionella	76
	Other genera	0
	Total	15,909
08/29/72	1. Anabaena	470
	2. Cyclotella	398
	3. Fragilaria	320
	4. Dinobryon	181
	5. Stephanodiscus	96
	Other genera	182
	Total	1,647
10/26/72	1. Anabaena	2,085
	2. Flagellates	1,281
	3. Stephanodiscus	528
	4. Dinobryon	452
	5. Melosira	301
	Other genera	1,459
	Total	6,106

2. Chlorophyll *a* -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
06/30/72	01	39.7
	02	45.9
08/29/72	01	0.4
	02	3.8
10/26/72	01	98.4
	02	40.3

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.062	0.595	16.2
0.005 P	0.067	0.595	15.3
0.010 P	0.072	0.595	15.1
0.020 P	0.082	0.595	16.4
0.050 P	0.112	0.595	16.3
0.050 P + 10.0 N	0.112	10.595	68.9
10.0 N	0.062	10.595	40.7

2. Discussion -

The control yield of the assay alga, *Selenastrum capricornutum*, indicates that the potential primary productivity of Buffalo Lake was high at the time the sample was taken. Also, the lack of significant increase in yield with increasing levels of orthophosphate, and the significant increase in yield with nitrogen alone or in combination with phosphorus, indicates the lake was nitrogen limited at the time of sampling.

The lake data indicate nitrogen limitation for all sampling periods; nitrogen to phosphorus ratios were 6 to 1 or less, and nitrogen limitation would be expected.

IV. NUTRIENT LOADINGS
(See Appendix C for data)

For the determination of nutrient loadings, the Minnesota National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page vi), except for the high runoff months of April and May when two samples were collected. Sampling was begun in October, 1972, and was completed in September, 1973.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Minnesota District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated by using the nutrient loads, in lbs/mi^2/year, in Mill Creek, at station A-1 and multiplying by the ZZ area in mi^2.

The operator of the Buffalo wastewater treatment plant provided monthly effluent samples and corresponding flow data.

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* See Working Paper No. 1.

A. Waste Sources:

1. Known municipal* -

Name	Pop. Served	Treatment	Mean Flow (mgd)	Receiving Water
Buffalo	2,950	trickling filter	0.413	Buffalo Lake

2. Known industrial - None

* Anonymous, 1974.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	lbs P/ yr	% of total
a. Tributaries (non-point load) -		
Mill Creek	5,740	30.4
Unnamed Creek (C-1)	620	3.3
b. Minor tributaries & immediate drainage (non-point load) -	1,630	8.6
c. Known municipal STP's -		
Buffalo	10,630	56.2
d. Septic tanks* -	50	0.3
e. Known industrial - None	-	-
f. Direct precipitation** -	240	1.2
Total	18,910	100.0

2. Outputs -

Lake outlet - Mill Creek 8,710

3. Net annual P accumulation - 10,200 pounds

* Estimate based on 30 permanent and 2 seasonal shoreline dwellings and 3 resorts; see Working Paper No. 1.
** See Working Paper No. 1.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	lbs N/ yr	% of total
a. Tributaries (non-point load) -		
Mill Creek	63,970	50.1
Unnamed Creek (C-1)	6,930	5.4
b. Minor tributaries & immediate drainage (non-point load) -	18,210	14.2
c. Known municipal STP's -		
Buffalo	22,240	17.4
d. Septic tanks* -	1,880	1.5
e. Known industrial - None	-	-
f. Direct precipitation** -	14,550	11.4
Total	127,780	100.0

2. Outputs -

Lake outlet - Mill Creek 113,400

3. Net annual N accumulation - 14,380 pounds

* Estimate based on 30 permanent and 2 seasonal shoreline dwellings and 3 resorts; see Working Paper No. 1.
** See Working Paper No. 1.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	lbs P/mi^2/yr	lbs N/mi^2/yr	N/P Ratio
Mill Creek	190	2,118	11/1
Unnamed Creek (C-1)	221	2,475	11/1

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving water would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

Units	Total Phosphorus		Total Nitrogen	
	Total	Accumulated*	Total	Accumulated
lbs/acre/yr	12.5	6.8	84.6	9.5
grams/m^2/yr	1.40	0.76	9.5	1.1

Vollenweider loading rates for phosphorus (g/m^2/yr) based on mean depth and mean hydraulic retention time of Buffalo Lake:

"Dangerous" (eutrophic rate)	0.38
"Permissible" (oligotrophic rate)	0.19

* The outlet station sampled is separated from Buffalo Lake by Deer Lake, and some sedimentation and/or biological assimilation of phosphorus in Deer Lake may have occurred. However, the hydraulic retention time of Deer Lake probably is short, and phosphorus accumulation there would be expected to be minimal.

V. LITERATURE REVIEWED

Anonymous, 1974. Wastewater disposal facilities inventory. MPCA, Minneapolis.

Anderson, Dennis, 1970. Report on investigation of the water quality and sources of pollution of Buffalo Lake, Wright County, Minnesota. MPCA, Minneapolis.

Ketelle, Martha J., and Paul D. Uttormark, 1971. Problem lakes in the United States. EPA Water Poll. Contr. Res. Ser., Proj. #16010 EHR.

Vollenweider, Richard A., (in press). Input-output models. Schweiz A. Hydrol.

VII. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR MINNESOTA 10/30/74

LAKE CODE 2713 BUFFALO LAKE

TOTAL DRAINAGE AREA OF LAKE 44.00

TRIBUTARY	SUB-DRAINAGE AREA	NORMALIZED FLOWS JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
271341	38.20	6.62	3.41	8.19	20.20	35.40	39.90	25.60	7.81	20.20	6.31	4.78	5.15	15.33
271341	44.00	9.60	5.20	11.30	29.20	50.50	56.10	36.40	15.40	28.40	9.30	7.20	7.40	22.22
2713C1	2.86	1.10	0.64	1.06	1.69	3.45	3.83	2.57	1.05	2.44	0.69	0.46	0.75	1.64
271377	10.40	1.97	1.06	2.47	6.79	12.40	14.60	7.40	3.38	7.59	2.11	1.49	1.68	5.25

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 44.00
SUM OF SUB-DRAINAGE AREAS = 43.94

TOTAL FLOW IN = 265.98
TOTAL FLOW OUT = 266.00

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
271341	10	72	17.10	14	17.00				
	11	72	20.40	18	24.00				
	12	72	14.80	19	14.00				
	1	73	23.90	28	17.00				
	2	73	9.34	19	9.20				
	3	73	32.40	10	19.00				
	4	73	35.80	8	41.00	23	26.00		
	5	73	38.90	13	36.00	27	41.00		
	6	73	25.90	17	23.00				
	8	73	6.01	16	5.10				
	9	73	10.50	25	4.40				
271341	10	72	26.00	14	26.00				
	11	72	31.40	18	38.00				
	12	72	22.10	19	20.00				
	1	73	35.90	28	26.00				
	2	73	14.60	19	14.00				
	3	73	45.90	10	28.00				
	4	73	53.10	8	61.00	23	38.00		
	5	73	57.10	13	53.00	27	61.00		
	6	73	37.60	17	34.00				
	7	73	10.90						
	8	73	12.20	16	10.00				
	9	73	15.20	25	6.40				
2713C1	10	72	1.86	14	1.90				
	11	72	1.98	18	2.30				
	12	72	2.16	19	2.00				
	1	73	3.97	28	2.40				
	2	73	1.32	19	1.30				
	3	73	4.19	10	2.50				
	4	73	6.10	8	7.00	23	4.40		
	5	73	3.80	13	3.50	27	4.00		
	6	73	2.49	17	2.20				
	7	73	0.75						
	8	73	0.81	16	0.68				
	9	73	1.27	25	0.53				

TRIBUTARY FLOW INFORMATION FOR MINNESOTA

LAKE CODE 2713 BUFFALO LAKE 10/30/74

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
271377	10	72	5.71	14	5.70				
	11	72	6.39	18	7.50				
	12	72	4.83	19	4.40				
	1	73	7.11	20	5.00				
	2	73	2.63	19	2.60				
	3	73	9.76	10	5.90				
	4	73	12.00	8	14.00	23	8.60		
	5	73	13.60	13	13.00	27	14.00		
	6	73	9.49	17	8.50				
	7	73	2.15						
	8	73	2.60	16	2.20				
	9	73	3.95	25	1.70				

APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/10/30

271301
45 10 15.0 093 52 44.0
BUFFALO LAKE
27 MINNESOTA

11EPALES
3

2111202
C019 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/30	17 30	0000	25.0	17.0		380	9.30	153	0.050	0.060	0.225	0.166
	17 30	0015	21.2	6.2		400	8.70	158	0.050	0.400	0.316	0.244
72/08/29	14 45	0000				380	8.45	167	0.030	0.820	0.182	0.162
	14 45	0004	23.1	5.6		380	8.50	170	0.070	0.690	0.181	0.157
	14 45	0015	19.7	1.4		380	8.25	167	0.060	0.970	0.186	0.080
72/10/26	09 00	0000			22	410	8.90	181	0.100	0.620	0.212	0.166
	09 00	0004	6.3	12.0		410	8.90	176	0.220	0.300	0.232	0.171
	09 00	0015	6.2	12.0		410	8.90	176	0.240	0.630	0.222	0.179

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/30	17 30	0000	39.7J
72/08/29	14 45	0000	0.4J
72/10/26	09 00	0000	98.4J

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/10/10

271302
45 09 24.0 093 53 40.0
BUFFALO LAKE
27 MINNESOTA

11EPALES 2111202
5 0013 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00316 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO3+NO2 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/30	17 15	0000		14.2		385	9.20	148	0.060	0.070	0.352	0.177
	17 15	0015		2.4		430	8.20	162	0.050	0.740	0.336	0.300
72/08/29	14 30	0000			72	380	8.50	162	0.060	0.740	0.172	0.152
	14 30	0006	22.3	4.2		390	8.43	153	0.060	0.710	0.167	0.158
	14 30	0015	19.4	4.4		390	8.30	154	0.070	0.810	0.140	0.157
72/10/24	09 15	0000			22	420	8.80	173	0.200	0.630	0.197	0.147
	09 15	0004	5.0	11.4		400	8.80	173	0.200	0.620	0.208	0.153
	09 15	0014	5.4	11.4		410	8.80	171	0.200	0.620	0.211	0.157

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLOROPHYL A UG/L
72/06/30	17 15	0000	45.41
72/08/29	14 30	0000	3.41
72/10/24	09 15	0000	40.31

J VALUE KNOWN TO BE IN ERROR

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APPENDIX C

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 74/10/30

27134A1 LS2713A1
45 10 18.0 093 54 30.0
MILL CREEK
27 15 HUFFALO
1/HUFFALO LAKE
CO HWY 35 BRDG 1.25 M W OF BUFFALO
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	13 30		0.190	1.675	0.096	0.066	0.150
72/11/18	15 25		0.815	1.300	1.094	0.068	0.105
72/12/19	13 00		0.745	1.500	0.105	0.052	0.090
73/01/20	11 30		0.650	1.830	0.310	0.126	0.160
73/02/19	12 20		0.700	1.440	0.194	0.134	0.200
73/03/16	10 30		1.140	3.100	0.780	0.400	0.575
73/04/09	11 45		0.0195	1.830	0.024	0.050	0.145
73/04/23			0.0195	1.405	0.096	0.037	0.135
73/05/13	10 50		0.0195	1.303	0.069	0.048	0.168
73/05/27	14 45		0.040	2.100	0.102	0.110	0.220
73/06/17	11 50		0.150	3.200	0.691	0.120	0.240
73/09/18	09 20		0.230	0.840	0.044	0.075	0.155
73/09/25	10 20		0.350	0.325	0.039	0.044	0.090

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 74/10/30

271381 LS271381
45 08 30.0 093 54 30.0
DEER LK OUTLET TO N FORK CROW RI
27 15 BUFFALO
O/BUFFALO LAKE
CO HWY 18 XING DOWNSTREAM OF DEER LAKE
11FRALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	11 00		0.142	4.200	0.480	0.154	0.310
72/11/19	15 00		0.230	3.200	0.580	0.126	0.189
72/12/19	12 25		0.270	2.400	0.460	0.094	0.132
73/01/20	12 00		0.290	2.100	0.560	0.104	0.135
73/02/19	12 45		0.300	2.300	0.580	0.126	0.160
73/03/10	11 00		0.430	2.900	0.920	0.210	0.360
73/04/08	12 00		0.046	2.700	0.034	0.024	0.230
73/04/23			0.010K	1.900	0.100	0.032	0.190
73/05/13			0.012	1.470	0.120	0.063	0.145
73/05/27	16 20		0.047	2.100	0.126	0.084	0.170
73/06/17	12 20		0.023	1.980	0.036	0.075	0.160
73/09/16	10 00		0.026	2.310	0.065	0.031	0.160
73/09/25	10 45		0.054	2.600	0.280	0.052	0.220

K VALUE KNOWN TO BE LESS THAN INDICATED

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STORET RETRIEVAL DATE 74/10/30

2713C1 LS2713C1
45 10 00.0 093 52 30.0
UNNAMED BUFFALO LK TRIB FROM E
27 15 BUFFALO
T/BUFFALO LAKE
ST HWY 25 XING IN BUFFALO LAKE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	10 45		0.330	0.750	0.105	0.048	0.138
72/11/13	14 45		0.150	1.300	0.140	0.048	0.100
72/12/19	12 15		0.460	0.560	0.147	0.019	0.100
73/01/20	13 40		0.560	3.900	1.200	0.132	0.270
73/02/19	12 40		1.000	2.600	1.200	0.110	0.340
73/03/19	10 45		0.510	3.600	0.995	0.595	0.820
73/04/08	11 50		0.060	2.000	0.031	0.042	0.200
73/04/23			0.220	1.470	0.044	0.046	0.140
73/05/13	10 55		0.240	1.520	0.050	0.061	0.150
73/05/27	16 35		0.130	1.600	0.048	0.190	0.260
73/06/17	12 05		0.540	1.300	0.130	0.100	0.195
73/08/16	09 45		0.560	0.730	0.115	0.070	0.170
73/09/25	10 30		0.360	0.460	0.042	0.595	

STORET RETRIEVAL DATE 74/10/30

271351 TF271351 P003275
45 10 30.0 093 53 30.0
BUFFALO
27 15 BUFFALO
D/BUFFALO LAKE
BUFFALO LAKE
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/01/23	10	30	6.500	11.500	0.700	7.100	7.750	0.373	0.391
73/02/08	10	30							
CP(T)-			6.200	13.000	0.610	4.300	8.100	0.400	0.387
73/02/08	12	30							
73/03/26	15	30	3.100	15.400	4.000	7.300	9.100	0.460	0.378
73/04/05	10	30	3.900	9.400	0.169	6.206	6.900	0.435	0.430
73/05/29	10	30	12.300	1.200	0.155	5.000	6.000	0.560	0.500
73/06/12	10	30							
CP(T)-			13.000	4.900	0.399	5.800	7.400	0.452	0.450
73/06/12	13	00							
73/07/16	08	00							
CP(T)-			18.400	2.800	0.220	8.000	10.000	0.376	0.405
73/07/17	08	00							
73/08/17	14	00	16.400	3.800	0.520	7.680	10.500	0.347	0.340
73/09/18	00	00							
CP(T)-			0.640	3.300	0.470	7.830	8.850	0.391	0.410
73/09/18	24	00							
73/10/22	08	00							
CP(T)-			14.600	3.700	0.008	7.400	10.000	0.423	0.460
73/10/23	08	00							
73/11/19	10	00							
CP(T)-			10.400	3.900	0.280	6.400	8.300	0.381	0.390
73/11/19	12	00							
73/12/17	11	00							
CP(T)-			16.400	5.200	0.255	6.650	8.800	0.420	0.409
73/12/17	14	00							
74/01/22	08	00							
CP(T)-			10.100	22.000	0.280	9.500	11.500	0.370	0.382
74/01/23	08	00							